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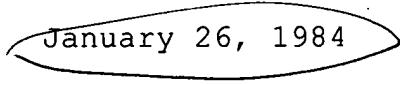
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**PRINT HEAD IN A LINE PRINTER**  
[Druckkopf bei einen Tintenzeilendrucker]

Märfred Wiedemer

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Inventor : Manfred Wiedemer  
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Patent Claims:

1. A print head, in which a spark discharge is generated in a slot containing ink and provided with an opening with the aid of at least two adjacent electrodes and the compressional wave generated thereby ejects a drop of ink through the opening of the slot, wherein the slot (30) is delimited by a printing plate (36) containing the opening (18), a first electrode (10), and a carrier (32) containing the second electrode (12) made of insulating material, and the tip of the second electrode (12) projects out of the carrier (32) into the slot (30) and is guided up to the vicinity of the first electrode (10), and wherein the opening in the printing plate (36) lies opposite to the gap formed by the ends of the two electrodes, in which the first electrode (10) consists of a U-shaped part, whose central part has a slot (30), the carrier (32) has a projection (34), which can be inserted in the slot of the first electrode (10), and the printing plate (36) is mounted on the first electrode (10) and seals off the slot.

2. The print head of claim 1, wherein the first electrode (10) is configured as a rod with U-shaped cross section, a

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<sup>1</sup> Numbers in the margin indicate pagination in the foreign text.

multitude of discoidal carriers (32) with respectively a second electrode (12) are arranged in the U-shaped part of the rod, and wherein the printing plate (36), which has a number of openings (18) that corresponds to the number of the second electrodes, is mounted on the central part of the rod.

The invention concerns a print head pursuant to the preamble of patent claim 1.

Printing processes without keystrokes are known. To these belong, for example, ink jet printing processes in which the ink is applied directly on the recording medium. The ink jet printing process can work with a continuous ink jet, wherein the jet or drop is electrostatically charged and deflected in such a way in its trajectory toward the recording medium that it forms the character to be printed. However, it is also possible to eject ink drops according to need and to assemble with these ink drops the character to be printed in the form of a matrix. If required, the ejection of the ink drop can be generated by means of an electromechanical converter. Finally, ink drops can be transferred onto the recording material by means of electrostatic tractive forces.

A process according to which drops of ink are generated according to need is known from United States patent 3,177,800 and German patent publication 6 83 985. Herein, the energy for

the ejection of the ink, for example, the ink or printing ink, is applied in the direction of the recording medium by means of a spark discharge between an electrode pair. If a drop is to be produced, short-term high voltage is applied via a circuit on the desired electrode pair. The spark that jumps from electrode to electrode vaporizes part of the ink present between the electrodes. The surrounding ink acts as a rigid wall due to its inert behavior, and a high pressure builds up, which propagates in all directions with a very high speed in the form of a percussion or shock wave. Through the opening of a hollow space in which the ink is arranged passes then a drop of the ink in the direction toward the recording medium, for example, a paper strip. The formation of satellite drops is prevented by means of the selected shape of the openings.

A print head for a high speed printer is also known from DE-OS 21 15 530, in which electrodes are arranged within a liquid dye, which form an electric discharge gap, wherein the electric spark generates an overpressure between the discharge gap within the liquid and as a consequence of this overpressure a specific quantity of liquid shoots through the nozzle opening. The head consists of an insulating material, in which the electrodes are installed. The nozzle opening itself serves as an electrode.

In order to achieve an amplification of the compressional wave or a concentration of the compressional wave in these print heads, it is known from the publication IBM Technical Disclosure Bulletin, Vol. 19, No. 6, November 1976, pages 2255 to 2256 to configure the nozzle opening in the shape of a funnel.

It is also possible to provide reflecting arrangements within the print head, which reflect the compressional wave for ejecting the individual drop. In this way, in United States patent 3,179,042 is described an ink printer; in which the compressional wave for ejecting a single droplet is reflected on the rear wall of the ink chamber of the print head.

Inside a print head, several single nozzles, which can be actuated separately via electrodes, can be integrated into a matrix print head as described in DE-OS 29 28 730.

All these print heads have, however, the disadvantage that they are relatively complicated in design and that in particular a print head in which several individual nozzles are arranged side by side is difficult to manufacture.

The object of the invention consists in presenting a print head of the kind mentioned above, which is easy to manufacture, and in which it is possible to arrange several nozzles in the form of a strip in such a way that the individual nozzles can be easily actuated without mutual influence.

This object is attained with the print head of the kind mentioned above pursuant to the characterizing part of the first patent claim.

The tip of the second electrode projects thereby out of the carrier into the hollow space and is brought up to the first electrode. Then, the opening lies in the printing plate opposite to the gap formed by the first electrode of the tip of the second electrode. The entire print head is extraordinarily easy to manufacture because the first electrode consists of a U-shaped part, the central part has a slot that coacts with a projection of the carrier, while the printing plate is mounted sealing the slot on the first electrode. /2

If several electrode pairs are to be arranged in the print head, then it is practical to provide only one single first electrode, which coacts with the mutually adjacent second electrodes. In this case, it is advantageous to configure the head pursuant to a further development of the invention in accordance with the second patent claim.

An embodiment of the invention is shown in the drawings and is described in more detail in the following as an example, wherein:

Fig. 1 shows an embodiment of the print head in cross sectional view,

Fig. 2 shows a frontal view of a print head with several electrode pairs, and

Fig. 3 shows a rear view of a print head with several electrode pairs.

The print head shown in Fig. 1 contains a first electrode 10 having a U-shaped cross section with a slot 30 in the central part. A second electrode 12 is arranged in a carrier 32 of insulating material. The carrier 32 has a projection 34 having a rectangular cross section, which can be inserted into the slot 30 of the first electrode 10 and seals off the same toward the inside, but does not completely fill out the slot 30. On the outer side of the central part of the first electrode 10 is mounted a printing plate 36, which seals off the slot 30 toward the outside. The printing plate 36 is provided with an opening 18, which is arranged in such a way that it lies at the height of a gap formed by the two electrodes 10 and 12, which is produced in that the tip of the second electrode is guided out of the carrier 32 and reaches up to the adjacent first electrode. ~~By means of the arrangement of the individual elements is produced a hollow space for accommodating the ink,~~ which consists of the slot 30 sealed off by the carrier 32 and the printing plate 36.

In order to operate such a print head, the ~~first electrode~~  
~~10 and the second electrode 12 are connected via a customary~~  
~~circuit arrangement to a high voltage in a manner that is not~~  
~~shown [in the drawings]. Always when a drop of ink is to be~~  
~~ejected from the opening 18, the circuit arrangement is~~  
~~actuated, and with this high voltage is applied on both~~  
~~electrodes 10 and 12. In this way is generated a spark~~  
~~discharge between the electrode 10 and the electrode 12, which~~  
~~has as a consequence a compressional wave, which then causes the~~  
~~ejeciton of a drop of ink from the opening 18 in the direction~~  
~~of a recording medium (which is not shown herein) via a funnel-~~  
~~shaped enlargement at the inner side of the opening 18 and at~~  
~~the opening 18 itself.~~

In the cross sectional illustration of Fig. 1 is only shown a single second electrode 12. If the print head is to contain a multitude of electrodes, however, a corresponding number of second electrodes 12 contained in carriers 32 are arranged side by side in a single first electrode 10. Such an exemplary embodiment results from Figs. 2 and 3. Fig. 3 shows a rear view of a print head with carrier 32, having respective electrodes 12, which coact with a single first electrode. The carriers 32 are held by two rods 38, 40.

Fig. 2 shows the frontal view and Fig. 3 shows the rear view of such a print head. In Fig. 2 can be seen the printing plate 36, which is mounted on the first electrode 10. The slot 30 for the ink is shown with dashed outline in Fig. 2. The ink is guided through a first channel 42 toward the slot 30 and is lead away again from the slot 30 via a second channel 44. The openings 18 are shown as dots in Fig. 2.

The openings 18 of such a print head can be arranged in such a way that one opening 18 is provided for each printing position seen in the direction of the lines of the recording medium. The opening 18 must thus have the size of the smallest possible image unit that can be represented on the recording medium. When an electrode pair is actuated, the ink is ejected through the opening 18 in the form of a drop corresponding in the size and shape to the opening 18 and is transferred onto the recording medium. The configuration of the individual dots as a character or image can occur in horizontal direction through an oscillating motion of the print head with respect to the recording medium or vice versa. In vertical direction, the configuration of the points is produced by means of the motion of the recording medium. The resolution, that is, the number of the smallest image units per character frame can be selected almost arbitrarily. The division in the vertical as well as

also in the horizontal direction can be below the smallest possible image unit, [that is], the drop. This means that a closed writing can be represented on the recording medium.

It is of course also possible to adapt the print head in its entire width to the width of the recording medium, so that a horizontal motion of the print head is not necessary.

